Southern Forest Experiment Station

Research Note

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Flooding, Beavers, and Hardwood Seedling Survival

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SUMMARY

Plantings were made for three successive years on clay-capped soils in the Mississippi River batture, the first year without flooding, and the second and third years with flooding. Species planted, but not in all years, were eastern cottonwood (*Populus deltoides* Bartr. ex Marsh.), sycamore (*Platanus occidentalis* L.), green ash (*Fraxinus pennsylvanica* Marsh.), sugarberry (*Celtis laevigata* Willd.), sweetgum (*Liquidambar styraciflua* L.), swamp chestnut oak (*Quercus michauxii* Nutt.), Shumard oak (*Quercus shumardii* Buckl.), and sweet pecan (*Carya illinoensis*, Wangenh., K. Koch). In years with flooding, beaver pulled up a fourth of the newly planted seedlings and ate the root systems. Height after 3 years, for trees planted in the first flood-free year, varied from 2.2 feet (sweet pecan) to 40.5 feet (cottonwood), and survival varied from 63 percent (cottonwood) to 97 percent (green ash). Species planted in years with flooding, omitting beaver-destroyed trees, had better than 70 percent survival except for Shumard oak, swamp chestnut oak, and sweetgum.

Additional keywords: *Populus deltoides, Platanus occidentalis, Fraxinus pennsylvanica, Celtis laevigata, Liquidambar styraciflua, Quercus michauxii, Quercus shumardii, Carya illinoensis.*

INTRODUCTION

Without adverse factors, survival of planted hardwood seedlings is usually adequate. However, flooding and animal damage may be very detrimental. This note provides information on hardwood survival for three successive years, the first without and the second and third with flooding and beaver problems.

METHODS

In 1977, a study was established on cleared ground in the Mississippi River batture at Ajax Bar in Issaquena County, Mississippi, to test and compare survival and growth of several commercial hardwood species after planting. Soils were Bowdre series on the high ridges and Tunica series on the low ridges and flats. Both soils had clay caps overlying loamy material, with a texture change occurring within the top 10 to 20 inches for Bowdre and within 20 to 48 inches for Tunica. The first planting was done in January and February 1977 and included nine plots each of sweetgum, sweet pecan, swamp chestnut oak, green ash and sugarberry, two plots of sycamore, and one of cottonwood. Plots were 22 rows of 22 trees, with the interior 12 rows of 12 trees being measurement plots. Spacing was 12 by 12 feet. The second planting, in February 1978, included nine plots of sweetgum, six plots of sweet pecan, ten plots of green ash, 19 plots of Shumard oak, two plots of sycamore, and one plot of cottonwood. Also, skips in the 1977 sweet pecan planting were sown with seed. The third planting, in January and February 1979, was a replanting or filling in of the green ash, sweetgum, and sweet pecan plots planted in 1978 along with nine of the Shumard oak plots and six new swamp chestnut oak plots.

Between April 20 and 26, 1978, seedlings planted in 1977 and 1978 were examined and tallied as to condition.[1] Sweet pecan and swamp chestnut oak

[1]Seedling condition classes were: dead, dormant, leafed out, dead or living leaves which had been water covered, beaver damaged, and missing.

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seedlings planted in 1977 were re-examined in May, and four Shumard oak plots were re-examined in May, June, and July.

Seedlings planted in 1979 were examined the first week of June or in mid-July 1979.

Heights were measured after the 1977, 1978, and 1979 growing seasons.

RESULTS

Flooding

Extent of flooding of plots was based on Mississippi River stage readings at Vicksburg, Mississippi, about 42 miles downstream from Ajax. With the river on a rise, backwater from an adjacent slough to the north of the study area began entering the planting at 32 feet (Vicksburg river stage). Flood stage at Vicksburg was 43 feet.

In 1977, the maximum river stage was 33.7 feet in April and water was not a problem.

In 1978, the river surpassed 32 feet on March 24, continued rising to a crest of 40.0 feet on April 11, then fell, but remained above 32 feet through April 25. A second rise was above 32 feet on May 10, crested at 37.4 feet on May 26, and then fell back to 32 feet on June 6. At the high water mark of 40 feet, only three spots (about 19 percent of the planting area) were not inundated.

Time between the water's receding in April to flooding again in May varied from 17 to 36 days. Plots with 16 days or less of total flooding (tables 1 and 2) were only flooded in April; plots with 24 days of flooding were flooded 18 days in April and 6 days in May; and plots with 48 days of flooding were flooded 27 days in April and 21 days in May.

In 1979, the river passed 32 feet on March 3 and did not return to that mark until June 13. By March 12, the water was already higher than it had gotten in 1978, and water stayed above that level until May 19. The crest was 47.9 feet from April 26 through 29.

Table 1.—*Number of days plots flooded, by maximum, intermediate, and minimum time intervals, and average height and survival of trees planted in 1977*

Species	Flood class	No. plots	No. days water on plots[1]		Survival			Average height		
			1978	1979	1977	1978	1979	1977	1978	1979
					Percent			*Feet*		
Sweetgum	Max.	2	48	95	75	71	62	1.3	2.4	3.6
	Mid.	6	28/36[3]	84/88	81	77	72	1.4	2.4	4.2
	Min.	1	24	83	81	80	79	1.3	2.7	4.6
Sweet pecan[2]	Max.	1	33	86	90	84	85	0.4	1.1	1.7
	Mid.	5	6/28	74/84	77	82	80	0.5	1.2	2.0
	Min.	3	0	67	79	89	81	0.5	1.5	2.8
Green ash	Max.	3	24	83	96	95	96	5.3	9.3	13.2
	Mid.	3	12	78	97	97	97	4.9	9.2	13.4
	Min.	3	6	74	97	97	97	5.7	9.9	14.1
Sugarberry	Max.	3	24	83	90	89	89	3.9	5.6	7.8
	Mid.	3	12	78	88	88	88	3.8	6.1	8.2
	Min.	3	6	74	86	86	86	3.6	6.1	8.2
Swamp chestnut oak	Max.	1	24	83	89	76	61	1.1	1.8	1.9
	Mid.	5	6/13	74/78	90	85	84	1.4	2.2	2.7
	Min.	3	0	67	89	87	87	1.5	3.6	5.0
Sycamore	Max.	1	0	65	96	96	96	6.9	14.0	22.0
	Min.	1	0	52	94	94	94	6.0	12.3	18.4
Cottonwood		1	0	52	66	64	63	9.7	23.7	40.5

[1]Values represent plot averages
[2]Missing planting spots seeded after 1977 growing season.
[3]Range of days flooded between intermediate plots.

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Beaver Damage

The first inkling of beaver damage came while observing the area at the high water mark in April 1978. Apparently staying in shallow water, the beaver grasped a newly-planted seedling about 3 to 4 inches above the ground, as indicated by teeth marks on the stem, pulled the seedling from the ground, ate the root system to about the root collar, and then dropped the stem at the planting site (fig. 1). Long rows of consecutively damaged trees were observed.

When damage to the seedlings was first discovered, samples of the cut-off stems were sent to four wildlife experts for examination. The unanimous evaluation was that beaver, rather than nutria, were responsible for the problem.

Beavers were generally not discriminating, destroying seedlings of all species. A possible exception was sycamore. Location of the sycamore plots could have been a factor, as adjacent Shumard oak plots were not as heavily damaged as oak plots in another area.

Beavers only destroyed seedlings adjacent to the rising or falling water line. They did not damage trees on unflooded ridges that were only 5 to 10 feet from the water line. Beaver damage occurred with both floods in 1978, but did not occur after the water receded in May. The beaver returned with the flood waters in 1979, and again destroyed newly-planted seedlings.

Seeding Survival

During 1977, seedlings were not flooded and there was no beaver damage. First-year survival ranged from 66 percent for cottonwood to 97 percent for green ash (table 1). Average total heights were between 0.5 feet (sweet pecan) and 9.7 feet (cottonwood).

In 1978, 1-year-old trees of all species had some foliation at the April flood. Most trees of green ash and sugarberry were tall enough to be above the floodwaters even though the water was 4½ feet deep in drains (fig. 2). About half the 1-year-old swamp chestnut oak and sweet pecan and all the sweetgum seedlings were submerged. Sycamore and cottonwood were not flooded.

Of the newly planted trees, 31 percent of the sweetgum, 36 percent of the cottonwood, and 81 percent of the sycamore had leafed out before the April flood. Less than 10 percent of the Shumard

Table 2.—*Number of days plots flooded, by maximum, intermediate, and minimum time intervals, and average height and survival of trees planted in 1978 and 1979*

Species	Flood class	No. plots	No. days water on plots[1]		Survival		Average height	
			1978	1979	1978	1979	1978	1979
					----Percent----		*-----Feet-----*	
Sweetgum[2]	Max.	3	46[5]	95[5]	60	67	1.0	1.4
	Mid.	3	18/24[6]	80/83	24	43	1.1	1.3
	Min.	3	11	76	35	48	1.2	1.4
Sweet pecan[2]	Max.	3	6	72	43	51	0.6	0.9
	Min.	3	0	67	60	73	0.6	1.1
Green ash[2]	Max.	4	48[5]	95[5]	73	82	2.6	5.4
	Mid.	4	13/32	78/86	52	75	2.4	4.6
	Min.	2	6	70	50	74	3.1	5.4
Shumard oak[3]	Max.	4	32	.....	0	....	....	....
	Mid.	11	13/20	.....	9	....	0.6	....
	Min.	4	8	.....	32	....	1.0	....
Swamp chestnut oak[4]	Max.	1	.....	90	....	16	....	0.6
	Mid.	4	.....	83	....	27	....	0.6
	Min.	1	.....	78	....	42	....	0.7
Sycamore		2	20	82	94	94	3.0	7.8
Cottonwood		1	24	83	72	72	6.5	12.2

[1]Values represent plot averages.
[2]Missing planting spots replanted after 1978 growing season.
[3]Not measured after 1979 growing season.
[4]Planted prior to 1979 growing season.
[5]Trapped water remained on portions of plots for more days than shown after flood receded.
[6]Range of days flooded between intermediate plots.

Figure 1.—*Beaver-damaged green ash seedling with root system missing and bark peeled from the base of the stem.*

oak seedlings were starting to leaf out when the water covered them. Sweet pecan and green ash leafed out above the water or soon after the water receded.

After the April 1978 flood, trees (of all species) which had been in the field a year retained healthy leaves which had emerged or remained above the flood waters. Newly-planted sweetgums, which had been submerged for 21 days, started leafing out almost immediately while Shumard oaks, which had been submerged from 13 to 21 days, were showing bud swell and a few small leaves.

The May 1978 rise covered all 1-year-old sweetgum plots, one-third of the sweet pecan, green ash, and sugarberry plots, and three-fourths of one swamp chestnut oak plot. Except for a few swamp chestnut oaks and sweet pecan, 1-year-old seedlings were not submerged by the May flood.

The May overflow covered some of the same newly-planted Shumard oaks, sweetgums and green ash that had been flooded in April. Shumard oaks appeared to have not recovered from the April flood as they had small, chlorotic-appearing leaves and buds which had stopped elongating. Sweetgums had leafed out between floods, but most green ash were still dormant.

After water receded in May, new sweetgum which had been defoliated for a second time, again put out new leaves within 2 to 3 weeks. Green ash seedlings put out initial leaves about 2 weeks after the May flood.

Survival of trees planted in 1978 and subjected to flooding, compared to first-year survival of the flood-free 1977 planting (eliminating beaver-removed trees), was similar for sycamore, cottonwood, and sweet pecan and 25 percent lower for green ash and sweetgum.

The species hurt most by flooding was Shumard oak (table 2). Number of dead Shumards doubled by the end of June, then doubled again by mid-July. Only 11 percent of the trees survived in flooded areas. On a few dry ridges, 50 percent of the trees lived.

Beaver destroyed 24 percent of the trees planted in 1978. By species, from 1 percent of the sycamore to 39 percent of the sweetgum were lost (table 3). Less than 50 of all trees planted in 1977 were damaged by beaver. They were cut within 2 feet of the ground, but resprouted after the water left.

In 1979 the plots were covered with water from 52 to 95 days (tables 1 and 2). Most trees had

Table 3.—*Seedling survival and destruction by beaver for 1978 and 1979 plantings or replantings*

Species	1978		1979	
	Survival	Beaver destroyed	Survival	Beaver destroyed
	Percent			
Sweetgum	40	39	53	24
Sweet pecan	52	31	62	26
Green ash	60	15	78	18
Shumard oak	12	24	[2]	43
Swamp chestnut oak	[1]	[1]	28	9
Sycamore	94	1	[1]	[1]

[1]Not planted.
[2]Not measured because of very low survival.

not leafed out before being inundated. Survival of newly-planted swamp chestnut oak seedlings was only 28 percent.

Beaver destroyed 25 percent of the trees on plots which had been either replanted or newly-planted.

For the plots originally planted in 1978, tree height growth and survival are confounded with beaver destruction and replanting to the extent that the value of such figures are questionable. The following results pertain only to the 1977 planting.

Trees planted during the first flood-free year seemed little affected by floods during the second and third year. There was practically no mortality of cottonwood, sycamore, green ash, and sugarberry. Sweetgum and swamp chestnut oak lost 3 to 5 percentage points each year with greatest losses in the longest-flooded plots (table 1). Sweet pecan survival could not be evaluated because missing spots after 1 year had been direct-seeded.

Flooding had a slight effect on growth within a species. Trees flooded the longest grew less than trees on higher plots except for sycamores, which were on a higher site. However, growth differences were only a foot or less for all species except swamp chestnut oak.

Average, yearly second- and third-year growth varied from approximately 1 foot for sweet pecan, swamp chestnut oak, and sweetgum to 2 feet for sugarberry, to 4 feet for green ash, to 7 feet for sycamore. Cottonwood grew 14 feet in the second year and 17 feet in the third year.

DISCUSSION AND CONCLUSIONS

One growing season without flooding would be most desirable in establishing hardwood plantations. Even the Shumard oak might have been able to tolerate the floodwaters had they been established for a year. This is based on Shumard which was planted along the Mississippi River and survived the 1973 and 1975 floods. However, if first-year flooding is a probability, then green ash and sycamore should be favored in planting because of their survival and growth characteristics.

On Sharkey clay soil, Baker (1977) observed first-year survival of 90 percent for sycamore and green ash, 80 percent for sweetgum, and only 20 percent for cottonwood where plantings were completely covered by water for 4 weeks in May. This was a ponded water rather than a flowing water situation.

Other planting tests involving sweet pecan, sweetgum, green ash, sycamore, and cottonwood on

Figure 2.—*Flood waters beginning to recede from green ash trees starting their second growing season (April 1978).*

Sharkey clay and Commerce silt loam (unpublished data) in Mississippi have demonstrated the same order of growth between species after 3 years as at Ajax, but magnitude of growth within species differed by sites.

The beaver problem could be much more serious than water. It is the first time, to our knowledge, that beavers have actually pulled seedlings out of the ground and destroyed the roots. Only newly-planted trees would be affected, but it happens so quickly and extensively, that complete destruction of a large-scale planting is entirely possible. Cutting of 2- or 3-year-old trees is not a major problem, since nearly all our hardwoods will resprout and likely lose very little growth (unless it occurs several years in succession).

The apparent lack of interest by beavers for sycamore, at least where other species are present, has been observed elsewhere. In an informal planting study in Coahoma County, Mississippi, beavers cut off nearly every cottonwood in most plots but did not bother any sycamore seedlings in adjacent plots.[2]

[2]Personal correspondence with Dr. James B. Baker, U.S. Forest Service, Monticello, Ark., July 22, 1980.

LITERATURE CITED

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